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AUTHOR Reiss, Philip; Reiss, Rosalind
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ABSTRACT

Adolescent educable retardates were presented a list of words which were organized into categories for half of the Ss and randomized for the other half. In addition, a sorting task preceded the list for half of the Ss. Ss were tested for recall after each of three trials. Responses were analyzed by two methods: one required responses of Ss organized into categories predetermined by the experimenter, and one used the organizational patterns of Ss. Contrary to predictions, the sorting task did not result in higher clustering or recall scores. However, organized list presentation resulted in significantly higher recall scores than did randomized presentation. Subjective organization scores could not be obtained due to the very low number of scoreable responses of this type. It was suggested that subjective organization reflects a concept-formation process while associative clustering involves concept-usage. (Author/KW)

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Exceptional Children Education Division
State University College at Buffalo
1300 Elmwood Avenue
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Abstract: Clustering and Subjective Organization in a Free Recall Task with Retardates: A Comparison of Two Methodologies

Philip Reiss and Rosalind Reiss

Adolescent educable retardates were presented a list of words. For half of the Ss the list was organized into categories; it was randomized for the other half. In addition, a sorting task preceded the list for half of the Ss. Ss were tested for recall after each of three trials. Responses were analyzed by two methods: one which required the Ss responses organized into categories pre-determined by E and one which used Ss own organizational patterns.

Contrary to predictions, the sorting task did not result in higher clustering or recall scores. However, it was found that organized list presentation resulted in significantly higher recall scores than randomized presentation.

Subjective organization scores could not be obtained due to the very low number of scoreable responses of this type. It was suggested that subjective organization reflects a concept-formation process while associative clustering involves concept-usage.

Clustering and Subjective Organization in a Free-Recall Task with Retardates: A Comparison of Two Methodologies

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PROBLEM AND OBJECTIVES

Spitz (1966) has attempted to analyze the learning deficit associated with mental retardation in terms of an inability to spontaneously organize (verbal) material to be learned. The degree to which Ss spontaneously organize verbal material has been assessed by Bousfield's measure of associative clustering (1953), which refers to the grouping of related words in free recall of a list. In effect, this measure requires that the S learn and use categories predetermined by the E. An alternative means of studying organization in free-recall has been devised and may be referred to as subjective organization. This method determines scores by the grouping of the words as they appear in Ss responses - regardless of any organizational criteria used by the E. Thus, if the same data were to be scored by both methods, it is possible that very different degrees of clustering might be found. (The procedure for obtaining Ss responses is the same for both systems.)

A number of studies have been performed which seek to identify factors which facilitate clustering and, in turn, recall among mentally retarded Ss (Gerjuoy et al, 1969; Bilsky & Evans, 1969). Appendix A contains a comprehensive review of literature of clustering studies with mentally retarded Ss. One of the findings that has been most consistent is that if the original list is presented in an organized manner, clustering and recall are improved. However, Gerjuoy (1966) reports that practice on a presented-clustered list did not facilitate clustering or recall on a subsequent non-organized list while Bilsky and Evans (1969) find the opposite. A further consideration of other practice effects seems worthwhile.

It has been assumed that a "clustering set" may be induced simply by asking Ss to recall words, in the absence of any suggestion about organization. Thus, it is not surprising to find conflicting results regarding practice on other lists. However, if prior to the free-recall task each S was asked to sort items it might be possible to induce a set which would facilitate later clustering and recall.

The present study evaluated the degree to which clustering was facilitated by (1) a preceding sorting task and (2) list organization. It was expected that Ss who performed the sorting task prior to the free-recall task would evidence greater clustering and recall than Ss who did not have the preceding task. Furthermore, Ss in the presented-clustered condition were expected to score higher than those in the presented-random condition. All responses were scored both for associative clustering and subjective organization. In each case, it was expected that clustering and recall scores would be correlated.

PROCEDURE

Subjects

The Ss were 48 adolescent educable retardates drawn from classes in the West Seneca State School. The Ss were randomly assigned to one of four experimental groups. There were no significant differences in CA, MA or IQ among the groups. For all Ss, mean age was 15.2 yrs. (S.D.=1.9), mean MA was 9.3 yrs. (S.D.=1.9) and mean IQ was 59.3 (S.D.=12.6).

Materials

Free-recall task: The items used were taken from Bilsky and Evans (1969). This 20-word list includes five words from each of four categories (food, clothing, animals, body parts). Each word was presented aurally and visually simultaneously.

Sorting task: Twenty simple line drawings were prepared and mounted on three by five inch cards. The pictures corresponded to the categories used in the free-recall list but the items were completely different. The items used were: jacket, tie, skirt, sock, mitten, pie, apple, frankfurter, banana, ice cream cone, goat, cow, fish, dog, chicken, head, ear, hand, arm and finger.

Method

Ss were randomly assigned to one of the following four treatment groups: I - sorting task, list presented randomly; II - no sorting, list presented randomly; III - sorting task, list presented clustered; IV - no sorting, list presented clustered. The procedure used for the free-recall task was the same as in Reiss (1968), except that each group received only one list and the aural presentation was supplemented by a visual display of the word on a 3x5 card. Two groups performed the sorting task prior to the free-recall task and two groups spent an equivalent amount of time (approximately 5 min.) in a neutral interaction with E. Half of all Ss had items presented in a random order and for the other half lists were presented clustered. Each S was given 3 trials on the appropriate list.

RESULTS

Subjective Organization

Fagan (1968) developed a ratio score of sequential consistency (SC) based upon the difference of two ratios: the ratio between observed and maximum repetitions minus the ratio between expected and maximum repetitions. SC is defined for any pair of trials as $SC = \frac{O\ (ITR)}{c-1} - \frac{c}{hk}$ when O(ITR) is observed intertrial repetitions; h, the number of items recalled on trial h; k, the number of items recalled on trial n+1; and c, the number of items common to the two recalls. Puff and Hyson (1967) report a high correlation ($r>.90$) between SO and ITR scores.

In the present study, the observed repetitions [O(ITR)] were so low as to preclude any further analysis of these scores. O(ITR)'s ranged from 0 to 4, with 36 of the 48 Ss scoring 0 on one or more trials. It was apparent, then, that few Ss were organizing recall in a manner measurable by this score within these trials. It is possible that the type of organization measured by this technique is apparent only over longer trial blocks; additional research could easily examine this suggestion.

Associative Clustering

The method of scoring clustering proposed by Bousfiekd (Gerjuoy & Spitz, 1966) was used since it takes into account the number of words recalled by S. Above-chance clustering was defined as the difference between observed clustering and expected clustering [O(R)-E(R)]. Expected repetitions (clustering), E(R), was defined by: $E(R) = \frac{m_1^2 + m_2^2 + m_3^2 + m_4^2}{n} - 1$ where m is the number of words recalled in each category and n is the total number of words recalled. Observed repetitions, O(R), is defined as the number of times a stimulus word is followed by one or more stimulus words from the same category. Repetitions, categorical instrusions and irrelevant intrusions were not included.

Associative clustering was analyzed by a Linquist (1958) Type III analysis of variance (Table I), with trials as the within factor and sorting and list organization as between factors. The main effect of list organization was significant ($p<.05$), with scores higher in the presented-clustered (3.12) than in the presented-random condition (1.19).

Recall Scores

Correlations between recall scores (number of words recalled on each trial) and associative clustering were significant on all 3 trials ($p<.05$). The analysis of variance of recall scores is summarized in Table II. The significant triple interaction is depicted by a graph in Fig. 1. Ss who had the sorting task scored lower than those who did not have it, although the difference appears to be non-significant. Scores generally increased over trials and were higher in the presented-clustered than presented-random condition.

Table 1

Summary Table of Analysis of Variance (Lindquist Type III) of Clustering Scores

Source	ss	df	ms	F
Between Ss	148.0	47		
B (sorting)	0.1	1	0.1	< 1
C (list organ.)	15.0	1	15.0	5.17*
BC	3.2	1	3.2	1.1
$error_b$	129.7	44	2.9	
Within Ss	138.1	96		
A (trials)	3.6	2	1.8	1.37
AB	3.0	2	1.5	1.14
AC	8.1	2	4.05	3.09
ABC	3.1	2	4.05	3.09
$error_w$	115.3	88	1.31	
Total	286.1	143		

$p < .01$

Table 2

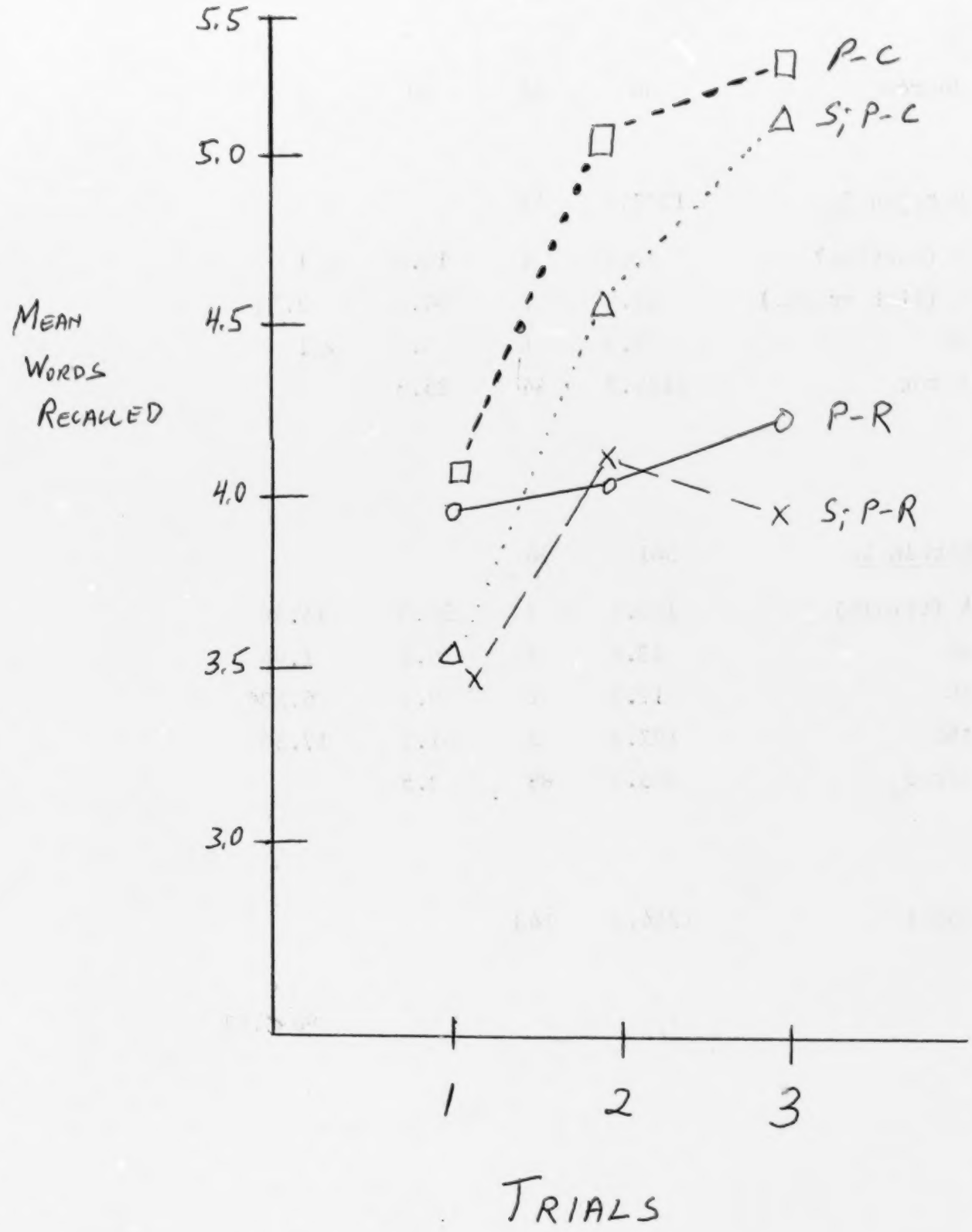
Summary Table of Analysis of Variance (Lindquist Type III) of Recall Scores

Source	ss	df	ms	F
Between Ss	1203.0	47		
B (sorting)	10.0	1	10.0	< 1
C (list organ.)	64.0	1	64.0	2.50
BC	3.3	1	3.3	<1
$error_b$	1125.7	44	25.6	
Within Ss	541	96		
A (trials)	100.5	2	50.3	14.4*
AB	13.6	2	6.8	1.94
AC	19.5	2	9.8	6.53*
ABC	102.5	2	61.3	17.5*
$error_w$	305.0	88	3.5	
Total	1744.0	143		

*$p < .01$

Figure 1

Mean Number of Words Recalled



Intrusions

Categorical and irrelevant intrusions were counted for each group. There were so few irrelevant intrusions that there was no need to analyze these data. Median numbers of categorical intrusions for each group were compared. Significantly fewer ($p<.05$) categorical intrusions were found in Group II (no sorting, presented random) than in any other condition.

DISCUSSION

The scoring of associative clustering by the use of the Bousfield and Bousfield (1966) formula has been generally accepted in free recall research with the mentally retarded. However, due to a paucity of studies, there has been little agreement on an appropriate subjective organization measure. The score system derived by Tulving (1962) is complicated and time consuming; in addition it requires that the number of trials equals the number of items. Bousfield and Bousfield (1966) proposed a measure called ITR (intertrial repetitions), an index of idiosyncratic organization. The modification of this score, derived by Fagan (1968), was selected for use in this study since it is applicable to any pair of trials. Furthermore, it is a ratio score based on a model similar to that used in the associative clustering score. Thus, this subjective organization score seemed most appropriate for a comparison with the Bousfield associative clustering score when scoring the same set of responses.

The two measures of clustering could not be statistically compared because a very limited number of responses could be scored by subjective organization. This measure hinges upon the number of intertrial repetitions (ITR); in the current study, no protocol included more than 4 ITR's. The computation of a subjective organization score would have been useless in this situation.

Similar results have been reported by Fagan (1969) and by Leicht and Johnson (1971). Fagan (1969) compared subjective organization scores (using the ITR measure) of mentally retarded and equal-MA (MA=9.8) normal children on a list of 10 letters. He found that the subjective organization scores did not differentiate normal from mentally retarded Ss and that all scores were very low, although recall scores of normal Ss were significantly higher than those of the mentally retarded Ss. Leicht and Johnson (1971) found that subjective organization scores (also based on numbers of ITR's) for both a category list and a trigram list were very low; total ITR's for each block of four trials ranged from 2 to 4.

The very low ITR scores in the present study might be attributed to having allowed Ss only three trials. Spitz (1966)

has reported that associative clustering scores reach above-chance levels only on the 4th and 5th trials of a 5-trial sequence. However, Laurence (1966) reports that while recall scores seem related to age of Ss and list length, there is no apparent improvement with practice in recall or subjective organization scores. Leicht and Johnson (1971) allowed Ss 6 trials on a list of words and 12 on a list of trigrams and Fagan (1969 allowed 10 trials on a list of letters; in both cases subjective organization scores were extremely low. Thus, number of trials, by itself, does not seem to be responsible for low subjective organization scores.

Laurence (1966) suggests that age of Ss and list length may be crucial determinants of subjective organization performance. She found marked differences in subjective organization scores when comparing fourth-grade children with adults; furthermore, additional practice did not seem to aid performance. Her results suggest that there may be some developmental level prior to which Ss cannot impose their own organizational scheme on unrelated words. The Ss used in the current study, as well as in the Fagan (1969) and Leicht and Johnson (1971) studies were of about fourth-grade level (MA 9 to 10). It remains to be clarified whether the ability measured by subjective organization is related to increased MA or IQ.

The scoring criteria for subjective organization and associative clustering differ in an important respect. The subjective organization scoring system depends upon the invariant sequencing of pairs of items on pairs of trials. This is much more demanding than the associative clustering system, which scores any sequence of members of a single category on a single trial, requiring only that items be contiguous during recall. Thus, associative clustering can score clustering on any single recall while subjective organization demands that a sequence be maintained over two or more recall trials. Tulving (1962) suggests means of scoring subjective organization in higher-order units, but points out that such a procedure is extremely complex.

It seems likely that subjective organization and associative clustering are, in fact, measuring different kinds of organizational behavior. Blount (1968) has suggested the need to differentiate concept-formation from concept-usage in studies of verbal learning. The subjective organization and associative clustering approaches in free recall learning may provide a means of doing so. Associative clustering seems to measure a subject's ability to use conceptual categories which are provided by the experimenter; indeed the more obvious these cues are made (either by indicating them in the instructions or presenting the items in categories), the higher subjects' scores are likely to be. If a subject is familiar with the concepts involved, his performance on this task will reflect his ability to store and retrieve material efficiently. The subjective organization task, on the other hand,

measures a subject's ability to analyze a group of words, synthesize some conceptual relationship among them and use this grouping to facilitate learning. The studies referred to previously indicate that this skill may require a more mature level of cognitive development than that which is involved in an associative clustering task.

The sorting task was intended as a form of pretraining, and was expected to improve clustering and recall scores; the hypothesis concerning this was not supported. Although there is agreement on the need to find methods to improve the grouping strategies of educable mentally retarded individuals (Blount, 1968; Herzog, 1968), successful pretraining has not yet been reported.

Spitz (1966) reported a study in which one group of mentally retarded Ss was given a sorting task two weeks prior to a free recall task; a second group received the tasks in the reverse order. Fourteen of twenty higher-IQ Ss ($\bar{X}_{IQ}$ = 72) were able to sort the pictures accurately while only two of the twenty lower-IQ Ss ($\bar{X}_{IQ}$ = 53) were able to do so. Despite this, there were no differences between the groups in recall or clustering scores. In the present study, eighteen of the twenty-four Ss performed the sorting task accurately. Here again, there seems to be no relation between sorting and performance on the free recall task.

In his critical review, Blound (1968) suggests that pretraining should be aimed at providing educable mentally retarded Ss with a wider repertoire of verbal superordinates. The sorting task used in the current study did not ask Ss to identify categories and gave very limited sorting practice. If any effect was discernible, it was that Ss who sorted achieved somewhat lower recall scores than Ss who did not sort.

In addition, the smallest number of categorical intrusions was found in a group which neither sorted nor received the items in the presented-clustered condition. This may indicate that Ss who have either sorted or received the presented-clustered condition have identified the appropriate category being used but have not yet retained only the specific items on the list. Thus, their recall responses include more categorical intrusions than do those of other Ss. It may be noted that most procedures which have increased the available cues in a free recall task (rhyming, instructions, etc.) have also increased the number of categorical intrusions (Reiss, 1968; Goulet, 1968; Spitz, 1966).

Two other results are worth noting briefly in that they replicate findings previously reported. That is, recall scores are significantly correlated with associative clustering scores and recall scores are higher in the presented-clustered than in the presented-random condition.

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Appendix A

Clustering in Free Recall: A Review of Research in Mental Retardation

Organizational processes have long been held to play an important role in learning. One of the most productive means of studying these processes has involved clustering in free recall learning. Two bodies of research in this area have developed, one concerned with the process in normal IQ individuals and the other concerned with the mentally retarded. Thomas J. Schuell (1969) has recently provided a comprehensive review of clustering research involving normal IQ subjects (mostly college students). This paper will review the relevant research in mental retardation and indicate points of divergence and convergence. The paper will be organized into three major sections. First, we will consider the theoretical positions which have generated research in this area. The second section will deal with the measurement of clustering. Finally, the research on bases of organizing verbal material and variables which influence organization will be discussed.

Theoretical Issues

The major impetus for clustering research in mental retardation derives from the work of Herman Spitz (1966) and his associates. Taking an approach from Gestalt psychology and information theory, Spitz analyzes learning in a seven step sequence:

(a)	arouse	(person is alerted)
(b)	attend	(attention is given to a specific stimulus)
(c)	input	(file into appropriate "hold" area)
(d)	hold	(hold for permanent storage)
(e)	recall	(retrieve material from temporary file, if necessary)
(f)	storage	(put into appropriate permanent file)
(g)	recall	(retrieve material from permanent file, if necessary)

Spitz, 1966, p. 53)

Spitz's central concern has been with step three - the manner in which input material has been organized.

Most free recall research involving mentally retarded subjects has been derived from this formulation. One study (Fagan, 1968) hypothesized a retardate deficit in immediate recall based on both Spitz's theory and Ellis' "stimulus-trace" theory; the data were more congruent with the former. At least two earlier studies (Osborn, 1960; Weatherwax & Benoit, 1957) derived from Hebbian theory.

Initial free recall research, based on Spitz's formulation, indicated that mentally retarded subjects showed a deficit relative to both equal-CA and equal-MA normal-IQ subjects. Later research proceeded to investigate means by which free recall performance of mentally retarded subjects could be facilitated, particularly through manipulations of stimulus input.

The theoretical positions reviewed by Shuell (1969) are directed towards a rather different goal - that is, they attempt to explain the phenomenon of clustering. Furthermore, clustering is discussed as

> basically an output phenomena from which we infer some sort of organizational process on the part of the subject ... The organization which is observed during recall could occur at the time of input ... or at the time of retrieval.
>
> (Shuell, 1969, p. 371)

Thus, while one group of researchers, working with normal-IQ subjects seeks to test various possible mechanisms underlying the organizing process, a second group, working primarily with mentally retarded individuals, seeks to identify means of increasing the efficiency of input organization. It is unfortunate that this work seems to proceed in a relatively isolated manner; scanning bibliographies shows little evidence of authors having compared findings.

The Measurement of Clustering in Free Recall

Two general paradigms have been developed for the study of clustering in free recall. The bulk of the research in both mentally retarded and normal IQ subjects has involved the use of a pre-determined organizational schema and is generally referred to as AC (associative clustering). In this paradigm, stimulus items are selected so that they belong to two or more mutually exclusive categories. Shuell (1969) refers to this as "categorical clustering," reserving the label AC for studies in which word association norms are used to generate lists. General practice in mental retardation research has been to use the AC label for both types of studies.

The second paradigm, SO (subjective organization), is based upon the use of essentially unrelated items; there has been relatively limited use of this paradigm in mental retardation research.

Shuell (1969) discusses very carefully a number of measures of organization which have been devised for use in clustering studies. He reports that most measures of AC, having fairly high intercorrelation, are roughly Bousfield (Gerjuoy & Spitz, 1966). This scoring measures organization in terms of a deviation between maximum possible clustering (corrected for the number of words recalled per category) and observed clustering. It has been used more frequently than any other measure in free recall research in mental retardation.

There has been greater consistency in the use of a measure of SO. Shuell (1969), comparing Tulbing's (1962) original model and the Fagan (1968) modification of Bousfield's ITR (intertrial repetition) scoring, favors Fagan's ratio measure. Although few studies in mental retardation have explored SO, the ITR measure seems more appropriate.

Although Shuell (1969) indicates that both paradigms deal with the same basic psychological process, this author has taken the position that they are rather different (Reiss & Reiss, 1971). Following Blount's (1968) differentiation of concept-formation and concept-usage studies, it has been suggested that AC is a measure of concept-usage while SO involves concept-formation. This hypothesis will be examined in a future study.

Variables Influencing Organization

Subject Characteristics: The research reviewed by Shuell (1969) shows little evidence of having considered subject characteristics as a class of variables which may affect organization in free recall. Laurence (1966) is one of the few such studies referred to; she reported age differences (favoring older subjects) in SO scores. Comparisons between mentally retarded subjects and both equal-CA and equal-MA normal IQ subjects have been important in defining the nature of the retardate input deficit (Gerjuoy, 1967). These findings seem to indicate that additional insight into the development of the skills related to organization might be gathered in a study which samples performance at a variety of intervals of IQ, MA and CA (Goulet, 1968).

Additional subject characteristics which may be relevant include socio-economic level, motivation and reading ability. Gerjuoy (1966) reports that free recall performance was improved by paying subjects for serving in experiments; although Evans (1964) found that offering a material reward served only to increase the number of intrusions. If this performance may consistently be affected by reinforcement, an additional means of improving the skill may be available.

Jensen & Fredenksen (1971) have reported clustering differences related to socio-economic level differences. Reiss & Weaver (1971) have proposed to study the effects of both reinforcement and socio-economic level on the free recall performance of educable mentally retarded subjects.

Two studies have attempted to relate clustering performance and reading disability. Evans (1970) found no relationship between reading level and either recall or clustering scores. However, Bilsky & Evans (1970) reported that subjects with higher reading comprehension scores had significantly higher clustering scores than subjects with lower reading comprehension scores. Among the differences in the studies are overall group differences in reading scores and the use of a general reading achievement score in one study (Evans, 1970) versus the use of a reading comprehension score in the other (Bilsky & Evans, 1970).

Materials: A variety of materials (pictures, words, letters, numbers, trigrams, objects) have been used as stimuli in free recall studies, although the majority of the studies have used only words. It is possible that the ease with which material is organized in recall is related to the type of material used as a stimulus item. There has not been systematic exploration of this in a study of free recall learning. However, Herzog (1968) presented a sorting task to mentally retarded Ss and found that the type of materials used (object, pictures, words) did not affect performance.

Presentation Variables: A number of variables involving the presentation of stimuli have been used in attempts to increase clustering scores. Gerjuoy and Spitz (1966) were the first to report effects of presentation variables on the clustering performance of mentally retarded subjects. They found that recall could be improved both by presenting the stimuli words organized into categories (presented-clustered) and by requesting organized recall; highest recall scores were obtained by a combination of boty. However, prior practice with such instructions was not found to transfer to performance on randomly organized lists with regular instructions (Gerjuoy, 1966; Reiss, 1968).

Bilsky and Evans (1970) report that scores on a presented-random list were increased when preceded by two trials on a presented-clustered list. However, the similarity of items and limited interval between training and transfer may account for this. McMillan (1970b) reports that the use of a presented-clustered list did not facilitate the performance of mentally retarded subjects. This attempt to replicate Spitz's (1966) study differed in that subjects were not required to name the stimuli as presented.

Gerjuoy and Spitz (1966) also noted that performance improved over trials with the most marked improvement in trials four and five of a five-trial block. However, although such effects have been noted by others (Evans, 1964; Evans, 1970; Leicht and Johnson, 1971; Reiss, 1968; Rossi, 1963), this effect has not been found to be lasting; scores on later trials, with delays of up to four days (Gerjuoy, 1967) were no better than scores on initial trials.

Although various kinds of pre-training experiences have been employed (naming categories, rehearsing stimuli, sorting), none have so far improved recall scores significantly (Blount, 1968; Leicht and Johnson, 1971; Reiss and Reiss, 1971). However, it remains possible that systematic specific pre-training, perhaps over a period of weeks, may improve this skill (Blount, 1968; Herzog, 1968).

An additional presentation variable which has been considered is the sensory channel by which the stimuli are presented. Studies using only a visual presentation have either used pictures as stimuli (Gerjuoy et al, 1969; Osborn, 1960) or have selected subjects for reading ability (Bilsky and Evans, 1970; McMillan, 1970a,b). There seemed to be few differences in performance which could be attributed to use of either sensory mode. Evans (1970) administered a task visually to one group, auditorially to another and via both channels to a third group. The recall scores of subjects receiving the bimodal

presentation were higher than those of subjects in either single mode condition; however, there were no differences in clustering scores.

Bases of organization: As has been indicated, stimuli in free recall studies have generally been selected so that they are related (AC) or unrelated (SO). In the latter instance, organization is imposed by the subject and may reflect any kind of idiosyncratic ordering. Few studies of SO have been done with mentally retarded subjects (Herriot and Box, 1971; Leicht and Johnson, 1971; Reiss and Reiss, 1971), although there has been a great deal of interest in this area of research with subjects of normal IQ (Shuell, 1969).

A second type of organization, based on word association norms, has frequently been employed in studies with normal-IQ subjects (Shuell, 1969). However, similar studies with mentally retarded subjects have been hampered by the non-existence of word association norms for this population (Gerjuoy, 1967). Thus, while Shuell differentiates between associative clustering and categorical clustering, most researchers in mental retardation have used the former term for any study in which stimuli are selected on some pre-determined dimension of relatedness. Most of these studies have used words which are members of a given conceptual category. Other relational bases which have been considered include rhyming (Menzel, 1966; Reiss, 1968), semantic categories (Simpson et al, 1970) and syntactic categories (Stedman, 1963). Findings have generally indicated no improvement of recall scores when performance on lists composed of these categories is compared to performance on lists of conceptual categories.

Organization and Recall: Results have generally indicated a positive correlation between organization and recall, both for normal IQ subjects (Shuell, 1969) and mentally retarded subjects (Blount, 1968; Goulet, 1968; Spitz, 1966). Indeed, it is just this relationship which has prompted the research on means of improving clustering; the objective of these studies is to ultimately improve recall. However, the correlation may be inflated since the clustering score includes a recall measure (Spitz, personal communication).

Implications for Education

Although the study of associative clustering in free recall learning began as a means of examining the role of input organization in retardate learning (Spitz, 1966), this phenomenon has relevance to concept formation (a form of organization) and to academic learning. Indeed, Spitz (1966) suggests that if material to be learned is presented to mentally retarded students in an appropriately organized manner, the teacher may thereby bring "retardates closer to their potential level of functioning," (1966, p. 54).

Blount's (1968) review provides some additional specific suggestions for improving the organizational conceptual schemata of retardates. He urges the use of verbal training measures since

> part of the retardate's problem appears to be the lack of public definitions for conceptual boundaries and thus the

> retardate defines concepts in terms that may be meaningful only to himself, (Blount, 1968, p. 282).

He reports that experimental strategies which have resulted in improved recall scores of mentally retarded subjects have either increased the cues provided or focussed the subject's attention more clearly on relevant cues.

Thus, it would appear that the mentally retarded subject does have the ability to organize material, but may be less able to maintain this organization and use it effectively. Herzog (1968) points out that mentally retarded subjects use fewer superordinate strategies (the most efficient grouping strategy) than normal IQ subjects. An effective training program might begin by using the subject's own categories aiding him to develop labels (superordinates) fo. these categories. Furthermore, Laurence's (1966) work suggests that the optimum number of items to be included may vary with different age levels. This, too, could be incorporated in the development of an individualized program. Bilsky and Evans (1970) have found that clustering scores are related to reading comprehension scores of mentally retarded subjects. If the organizational skills involved in clustering do contribute to the development of reading skills, it is hoped that a program which fosters the development of organizational skills will ultimately be of value in improving reading achievement. The features of a possible training program and a study of their effectiveness will be systematically explored in a future study (Reiss, 1970).

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